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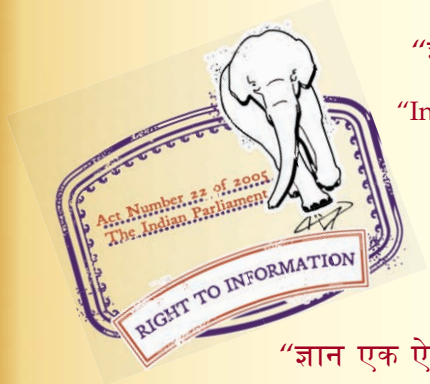
IS 12615 (2011): Energy Efficient Induction Motors - Three Phase Squirrel Cage [ETD 15: Rotating Machinery]



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भारतीय मानक

उर्जा दक्ष प्रेरण मोटरें — तीन फेज़ी स्किय़ेरल केज

(दूसरा पुनरीक्षण)

Indian Standard

ENERGY EFFICIENT INDUCTION MOTORS — THREE PHASE SQUIRREL CAGE

(Second Revision)

ICS 29.160.30

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

August 2011 **Price Group 4**

Rotating Machinery Sectional Committee, ETD 15

FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Rotating Machinery Sectional Committee had been approved by the Electrotechnical Division Council.

This standard specifies the performance requirements and efficiency of three phase squirrel cage energy efficient induction motors.

This standard was first published in 1989 and revised in 2004 to include two types of energy efficiency values. This revision has been contemplated to bring it line with IEC 60034-30 : 2008 'Rotating electrical machines — Part 30: Efficiency classes of single-speed, three-phase, cage-induction motors', to the extent possible for efficiency classes of 3 phase squirrel cage induction motors referring to related standard IS 15999 (Part 2/Sec 1) : 2011/IEC 60034-2-1 : 2007* 'Rotating electrical machines — Part 2-1: Standard methods for determining losses and efficiency from tests (excluding machines for traction vehicles)' on the methods of testing. Hence a need was felt to harmonize standard with the international practices to the extent possible.

Electric motors are the most important type of electric load in every industry. The motor driven systems account for about seventy percent of the energy consumed by the industry. There is a large potential for cost effective solution in the use of energy efficient motor systems by about twenty to thirty percent. Electric motor systems include a number of energy using products, such as motors, drives, pumps or fans, compressors, blowers and other machines. Energy efficient motors form a major component in contributing to the energy saving by way of increased efficiency of the product itself. Therefore, attempts are being made globally to develop and implement standards specifying higher efficiencies of motors and removal of lower efficiency from the standards itself. Further, with the different test methods specified in different standards, one to one comparison becomes difficult for the buyer or the end user. Therefore a need was felt globally to harmonize the motor standards with the international standards so as to have uniform test procedures to facilitate the end user to compare the performance and energy efficiency requirements.

Acknowledging the need for energy saving in view of the energy scarcity, climate change mitigations and the potential that exists with energy efficient motors, number of countries have issued directives to withdraw lower efficiency classes and adopt higher efficiency class motors as per IEC 60034-30 thus defining minimum efficiency performance standards (MEPS) in their countries. Such regulations are expected to impose technical barriers to all the imports of motors which are with lower efficiency classes than the MEPS in to their countries. Keeping in view the threats to the exports to India and also complimenting the role of various Government initiatives like National Mission for Energy Efficiency, it is intended that the efficiency levels of the motors covered in this standard need to be upgraded in a phased manner as per the below schedule:

a) The second revision shall be implemented by 30 June 2011.
b) The efficiency performance values of the motors under the scope shall be IE2. However, when these motors are used with variable frequency drives, they shall conform to IE1 values of efficiency.
c) The efficiency performance values of the motors under the scope shall be IE3 and shall be effective by 31 January 2014. However, when these motors are used with variable frequency drives, they shall conform to IE2 values of efficiency.

It has to be noted that the time lines for mandatory regulations imposed in different countries to set minimum efficiency performance standards (MEPS) for general purpose motors covered under the scope of IEC 60034-30 are not far after the global harmonization of standards. Needless to say, in most of the countries, the MEPS of IE1 are already in place. With the new regulations, after June 2011, most of the major motor markets will be facing the MEPS of IE2. Hence, this standard proposes to specify IE1 motors only when used with variable frequency drives.

*Under print.

(*Continued on third cover*)

Indian Standard

ENERGY EFFICIENT INDUCTION MOTORS — THREE PHASE SQUIRREL CAGE

(Second Revision)

1 SCOPE

1.1 This standard covers the requirements and performance of energy efficient, 3 phase squirrel cage induction motors in 2, 4, 6 poles for frame sizes from 71 up to and including 315L having output ratings as specified in IS 1231 : 1974 'Dimensions of three-phase foot-mounted induction motors' for continuous duty (S1) operation with service factor 1.0 or S3 (intermittent periodic duty) with a cyclic duration factor of 80 percent or higher, at rated voltage and frequency of 415 V, 50Hz.

NOTE — The ratings and related frame sizes are given in the tables given at the end with relevant performance values.

1.2 The performance of motors designed for operation on voltage other than rated voltage mentioned in **1.1** but up to 1 000 V, shall be in accordance with the relevant performance values specified in Tables 1 to 3 except for the full load current values. The full load current will vary in the inverse proportion to the voltage in comparison to the values specified in Tables 1 to 3.

1.3 To conform to this standard and eligible to be considered as energy efficient, the motors shall meet the norms specified in Tables 1 to 3 when read in conjunction with **4** related to site conditions as applicable. All performance values are subjected to tolerances specified in IS/IEC 60034-1 : 2004 'Rotating electrical machines — Part 1: Rating and performance' except that these tolerances are not applicable on speed and breakaway torque specified in Tables 1, 2 and 3.

NOTE — This standard does not apply to:

a) motors made exclusively for converter duty application;

b) motors completely integrated into the machine (for example, pumps, compressors, special machines, etc) that cannot be tested separately from the machine; and

c) motors rated for duty cycles S4 and above except if an equivalent S1 duty is specified by the driven equipment manufacturer.

2 REFERENCES

The standards listed in Annex A are necessary adjuncts to this standard.

3 TERMINOLOGY

For the purpose of this standard the definitions given in IS 1885 (Part 35) and IS/IEC 60034-1 shall apply.

4 SITE CONDITIONS

The following shall constitute the normal site conditions.

4.1 Altitude and Temperature

Motors shall be designed for the site conditions specified in **4.1.1** and **4.1.2** unless otherwise agreed to between the manufacturer and the purchaser.

4.1.1 *Altitude*

Altitude not exceeding 1 000 m (*see* IS/IEC 60034-1).

4.1.2 *Temperature*

The cooling air temperature not exceeding 40°C (*see* IS/IEC60034-1).

4.2 Electrical Operating Conditions

4.2.1 Clause **7** of IS/IEC 60034-1 shall apply.

4.2.2 *Form and Symmetry of Voltages and Currents*

The motors shall be so designed so as to be able to operate on virtually sinusoidal and balanced voltage conditions as defined in **7.2.1** of IS/IEC 60034-1.

4.3 Voltage and Frequency Variation

Motors shall be capable of delivering rated output with,

a) terminal voltage differing from its rated value by not more than ±10 percent, or

b) frequency differing from its rated value by not more than ±5 percent, or combined variation — the sum of absolute percent variations of (a) and (b) not exceeding 10 percent.

NOTE — In the case of continuous operation at the extreme voltage limits specified at (a), the temperature rise limits of the winding specified in IS/IEC 60034-1 shall not exceed by more than 20 ºC. In such cases, motor may be designed with higher class of insulation. Motors operated under the extreme conditions of voltage and/or frequency specified in (a) and (b), the performance values given in Tables 1, 2 and 3 may not necessarily comply with this standard.

4.4 Location, Moisture and Fumes

It shall be assumed that the location, moisture or fumes shall not seriously interfere with the operation of the motor.

5 TYPE OF ENCLOSURES

The motors shall have at least IP 44 or better degree of protection provided by the enclosures as specified in IS/IEC 60034-5.

6 METHODS OF COOLING

The method of cooling shall be IC 411 in accordance with IS 6362/IEC 60034-6.

7 STANDARD VOLTAGE AND FREQUENCY

7.1 Rated Voltage

The preferred rated voltage shall be 415 V (*see also* **1.2**).

7.2 Rated Frequency

The rated frequency shall be 50 Hz.

8 DUTY AND RATING

The motors shall be rated for duty type S1 (continuous duty) as specified in **4.2.1** of IS/IEC 60034-1 or S3 (intermittent periodic duty) with a rated cyclic duration factor of 80 percent or higher. This standard shall not be applicable to the motors with duty cycles S2, S4 and above. When an equivalent S1 duty is specified by the driven equipment manufacturer and in case equivalent duty (power) lies between two specified power ratings given in Tables 1, 2 and 3, the efficiency value shall be calculated using the formula given in **17.4**.

9 DIMENSIONS, FRAME NUMBER AND OUTPUT RELATIONSHIP

9.1 The fixing dimensions and shaft extensions of motors shall conform to the values specified in IS 1231 and IS 2223 as relevant.

9.2 The relationship between output, in kW, and frame number shall be according to IS 1231.

10 EARTHING

The earthing on the motor shall be provided in accordance with IS 3043.

11 OVERLOAD

11.1 Momentary Excess Torque

The motor shall be capable of withstanding 1.6 times the rated torque for 15 s without stalling or abrupt change in speed (under gradual increase of torque), the voltage and frequency being maintained at their rated values.

11.2 Pull-up-Torque

Unless otherwise specified, the minimum *pull-up-torque* of motors, at rated voltage and frequency shall be at least 0.5 times the rated full load torque.

11.3 Sustained Overloads

Motor rated in accordance with this standard are not expected to be capable of carrying sustained overloads.

12 TEMPERATURE RISE

12.1 The determination of the temperature rise of motors delivering rated output under rated conditions of voltage, frequency shall be in accordance with IS/IEC 60034-1.

12.1.1 The limits of temperature rise when measured by resistance method shall be not more than 80°C over an ambient of 40°C for motor with Class B or Class F insulation.

NOTE — It is recommended to design the motor with Class F insulation.

13 LIMITS OF VIBRATON

The motors shall conform to 'Vibration Grade A' of IS 12075.

14 PERFORMANCE VALUES

14.1 Operating at rated voltage and rated frequency, the performance of the motor at rated conditions shall be as specified in Tables 1 to 3. All the performance values are subject to tolerance as specified in IS/IEC 60034-1.

14.2 The value of full load current shall be taken as the average of the currents measured in all the three phases.

14.3 For motors having rated voltage other than 415V, the performance of the motor shall be as per the values in the relevant tables, except that the value of the maximum full load current would change in the inverse proportion of the voltage.

14.4 The value of the locked rotor current shall be as per Tables 1 to 3.

NOTE — Energy efficient cage-induction motors are typically built with more active material to achieve higher efficiency and hence the starting performance of these motors differs somewhat from motors with a lower efficiency. The locked-rotor current increases approximately by 10 to 15 percent for increase in each level of efficiency for the same output power and the values are as given in the Tables 1 to 3.

15 NOISE LEVEL

The noise level of motors shall be as given in IS 12065.

16 TERMINAL MARKING

The terminal markings shall be as given in IS/IEC 60034-8.

17 EFFICIENCY

17.1 For compliance with the requirements of this standard, the values of efficiency listed under appropriate efficiency class will be as per Tables 1, 2 and 3. The values given in Tables 1, 2 and 3 are subject to tolerance as specified in IS/IEC 60034-1. The efficiency classes are described in the following table:

Efficiency Class	*Description*	*Definition*
IE1	Only for variable frequency drive application	Motors with rated full load efficiency ≥ the corresponding limits listed in Tables 1, 2 and 3
IE2	High	
IE3	Premium	
IE4	Super premium	Under consideration

NOTE — Efficiency class of IE 4 is under consideration and would be incorporated at a later date by reducing the losses further than IE3 levels.

17.2 The losses and efficiency of these motors shall be calculated according to IS 15999 (Part 2/Sec 1).

NOTE — The selected test method shall be stated in the test certificate. Test methods with low uncertainty as specified in **8.1.1** or **8.1.2** or **8.2.1** or **8.2.2.5.1** of IS 15999 (Part 2/Sec 1) as applicable shall be used. Alternatively test as per assigned loss method as per IS/IEC 60034-1 may be applied.

17.3 To ensure a representative test result for windage and friction losses and in accordance with the common practice, the test shall be carried out in a stabilized bearing condition. In the case of motors provided with seals and other auxiliary devices like external fans, mechanical brakes, back stops, speed sensors, tacho generators etc, in various combinations, tests shall be conducted without installing the seals and other auxiliaries.

17.4 For general use the following formula may be applied for interpolation of intermediate ratings:

$$= A \cdot [\log_{10} (P_N/1\text{kW})]^3 + B \cdot [\log_{10} (P_N/1\text{kW})]^2 + C \cdot [\log_{10} (P_N/1\text{kW})] + D$$

where

A, B, C and D are interpolation coefficients; and

P_N is given, in kW (output for which efficiency is to be calculated).

The resulting efficiency (percent) shall be rounded off to the nearest tenth, that is xx.x percent.

The interpolation coefficients in respect of different IE codes are given in the following table:

IE Code	*Coefficients*	*50 Hz up to 200 kW*		
IE1	*A*	0.5234	0.5234	0.0786
	B	-5.0499	-5.0499	-3.5838
	C	17.4180	17.4180	17.2918
	D	74.3171	74.3171	72.2383
IE2	*A*	0.2972	0.0278	0.0148
	B	-3.3454	-1.9247	-2.4978
	C	13.0651	10.4395	13.2470
	D	79.077	80.9761	77.5603
IE3	*A*	0.3569	0.0773	0.1252
	B	-3.3076	-1.8951	-2.613
	C	11.6108	9.2984	11.9963
	D	82.2503	83.7025	80.4769

NOTE — When used with variable frequency drive, the efficiency of the motor can be one class lower for IE2 and IE3 class motors. For example a standard IE3 motor can have a efficiency value of IE2, when used with variable frequency drive.

17.5 When used with variable frequency drive, the efficiency of the motor can be one class lower for IE2 and IE3 class motors. For example a standard IE3 motor can have an efficiency value of IE2, when used with variable frequency drive**.**

18 MARKING AND LABELLING

18.1 Marking on the rating plate shall be as given in **10** of IS/IEC 60034-1.

18.2 The motors may be marked with appropriate efficiency class (for example, IE2, IE3, etc) on the name plate immediately after the efficiency value and reference to this standard.

18.3 BIS Certification Marking

The motors may also be marked with the Standard Mark.

18.3.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the license for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

19 TESTS

19.1 Dimensions

The dimensions of the motors shall be as specified in IS 1231, IS 2223 and IS 2254 as applicable.

19.2 Measurement of Resistance of Windings of Stator

The method of measurement and the requirement

shall be as given in **8.6** of IS/IEC 60034-1 and **5.7** of IS 15999 (Part 2/Sec 1).

19.3 No Load Test at Rated Voltage to Determine Input Current, Power and Speed

The tests shall be carried out as given in IS 15999 (Part 2/Sec 1) and **9.1** of IS/IEC 60034-1.

19.4 Reduced Voltage Running up Test at No Load (for Squirrel Cage Motors Up to 37 kW Only)

The tests shall be carried out as given in IS 15999 (Part 2/Sec 1).

19.5 Locked Rotor Readings of Voltage, Current, Power Input and Torque at a Suitable Reduce Voltage

The tests shall be carried out as given in IS 15999 (Part 2/Sec 1).

19.6 Full Load Test to Determine Efficiency, Power Factor and Slip

The tests shall be carried out as given in IS 15999 (Part 2/Sec 1).

19.7 Temperature Rise Test

The method of measurement and the requirement shall be as given in **8** of IS/IEC 60034-1.

19.8 Momentary Overload Test

The tests shall be carried out as given in IS 15999 (Part 2/Sec 1).

19.9 Insulation Resistance Test

The tests shall be carried out as given IS 7816.

19.10 High Voltage Test

The tests shall be carried out as given in **9.2** of IS/IEC 60034-1.

19.11 Test for Vibration Severity of Motor

The tests shall be carried out as given in IS 12075.

19.12 Test for Noise Levels of Motor

The tests shall be carried out as given in IS 12065.

19.13 Test for Degree of Protection by Enclosure

The tests shall be carried out as given in IS/IEC 60034-5.

19.14 Temperature Rise Test at Limiting Values of Voltage and Frequency Variation

The tests shall be carried out as given in **8** of IS/IEC 60034-1.

19.15 Over Speed Test

The tests shall be carried out as given in **9.7** of IS/IEC 60034-1.

19.16 Test on Insulation System

19.16.1 *Tangent Delta and Delta Tangent Delta Test*

The requirements and method of test shall be as per IS 13508.

19.16.2 *Impulse Voltage Withstand Test*

The requirements and method of test should be as per IS 14222.

20 TEST CERTIFICATES

20.1 Unless otherwise specified, the purchaser shall accept manufacturer's certificate as evidence of compliance of the motor with the requirements of this standard together with a type test certificate on a motor identical in essential details with the one purchased, together with routine tests on each individual motor.

20.2 Certificate of routine tests shall show that the motor purchased has been run and has been found to be electrically and mechanically sound.

21 SCHEDULE OF TESTS

21.1 Type Tests

The following shall constitute type tests:

a) Dimensions;
b) Measurement of resistance of windings of stator;
c) No load test at rated voltage to determine input current power and speed;
d) Reduced voltage running up test at no load (for squirrel cage motors up to 37 kW only);
e) Locked rotor readings of voltage, current, power input and torque at a suitable reduce voltage;
f) Full load test to determine efficiency, power factor and slip;
g) Temperature rise test;
h) Momentary overload test;
j) Insulation resistance test; and
k) High voltage test.

21.2 Optional Tests

The optional tests shall be carried out as per the mutual agreement between the manufacturer and the purchaser.

a) Test for vibration severity of motor;
b) Test for noise levels of motor;

c) Test for degree of protection by enclosure;
d) Temperature rise test at limiting values of voltage and frequency variation;
e) Over speed test; and
f) Test on insulation system.

21.3 Routine Tests

The following shall constitute the routine tests:

a) Insulation resistance test;
b) Measurement of resistance of windings of stator;
c) No load test;
d) Locked rotor readings of voltage, current and power input at a suitable reduced voltage;
e) Reduced voltage running up test; and
f) High voltage test.

Table 1 Values of Performance Characteristics of 2 Pole Energy Efficient Induction Motors
(*Clauses* 1.2, 1.3, 4.3, 8, 14.1, 14.4 *and* 17.1)

Sl No.	Rated Output	Frame Size	Full Load Speed	Full Load Current	Breakaway Torque in Terms of Full Load Torque	Breakaway Current in Terms of Full Load Current (Equal of Below)			Nominal Efficiency		
						IE1	IE2	IE3	IE1	IE2	IE3
			Min	*Max*	*Min*						
	kW		Rev/min	A	Percent	Percent	Percent	Percent	Percent	Percent	Percent
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
i)	0.37	71	2 750	1.2	170	600	650	700	66.1	72.2	75.5
ii)	0.55	71	2 760	1.6	170	600	650	700	69.1	74.8	78.1
iii)	0.75	80	2 780	2.0	170	600	650	700	72.1	77.4	80.7
iv)	1.1	80	2 790	2.8	170	600	650	700	75.0	79.6	82.7
v)	1.5	90S	2 800	3.7	170	600	650	700	77.2	81.3	84.2
vi)	2.2	90L	2 810	5.0	170	650	700	770	79.7	83.2	85.9
vii)	3.7	100L	2 820	8.0	160	650	700	770	82.7	85.5	87.8
viii)	5.5	132S	2 830	11.0	160	650	700	770	84.7	87.0	89.2
ix)	7.5	132S	2 840	15.0	160	650	700	770	86.0	88.1	90.1
x)	11.0	160M	2 860	21.5	160	650	700	770	87.6	89.4	91.2
xi)	15.0	160M	2 870	29.0	160	650	700	770	88.7	90.3	91.9
xii)	18.5	160L	2 880	35.0	160	650	700	770	89.3	90.9	92.4
xiii)	22.0	180M	2 890	41.5	160	650	700	770	89.9	91.3	92.7
xiv)	30.0	200L	2 900	54.0	160	650	700	770	90.7	92.0	93.3
xv)	37.0	200L	2 900	67.0	160	650	700	770	91.2	92.5	93.7
xvi)	45.0	225M	2 955	80.0	160	650	700	770	91.7	92.9	94.0
xvii)	55.0	250M	2 960	95.0	160	650	700	770	92.1	93.2	94.3
xviii)	75.0	280S	2 970	130.0	160	650	700	770	92.7	93.8	94.7
xix)	90.0	280M	2 970	150.0	160	650	700	770	93.0	94.1	95.0
xx)	110.0	315S	2 980	185.0	160	650	700	770	93.3	94.3	95.2
xxi)	125.0	315M	2 980	209.0	160	650	700	770	93.4	94.5	95.3
xxii)	132.0	315M[1)]	2 980	220.0	160	650	700	770	93.5	94.6	95.4
xxiii)	160.0	315L[1)]	2 980	265.0	160	650	700	770	93.8	94.8	95.6
xxiv)	200.0	As per manufacturer catalogue	2 980	340.0	160	650	700	770	94.0	95.0	95.8
xxv)	250.0		2 980	425.0	160	650	700	770	94.0	95.0	95.8
xxvi)	315.0		2 980	536.0	160	650	700	770	94.0	95.0	95.8
xxvii)	355.0		2 980	604.0	160	650	700	770	94.0	95.0	95.8
xxviii)	375.0		2 980	604.0	160	650	700	770	94.0	95.0	95.8

NOTES

1 Output to frame size relation is maintained in accordance with IS 1231 for all motors except those marked as [1)], wherein the frame size indicated is 'preferred size'.

2 The performance values given in this table for 0.37 kW and 0.55 kW are under consideration and subject to review.

Table 2 Values of Performance Characteristics of 4 Pole Energy Efficient Induction Motors
(*Clauses* 1.2, 1.3, 4.3, 8, 14.1, 14.4 *and* 17.1)

Sl No.	Rated Output	Frame Size	Full Load Speed	Full Load Current	Breakaway Torque in Terms of Full Load Torque	Breakaway Current in Terms of Full Load Current (Equal of Below)			Nominal Efficiency		
						IE1	IE2	IE3	IE1	IE2	IE3
			Min	*Max*	*Min*						
	kW		Rev/min	A	Percent	Percent	Percent	Percent	Percent	Percent	Percent
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
i)	0.37	71	1 330	1.4	170	550	600	650	65.1	70.1	73.0
ii)	0.55	80	1 340	1.7	170	550	600	650	69.1	75.1	78.0
iii)	0.75	80	1 360	2.2	170	550	600	650	72.1	79.6	82.5
iv)	1.1	90S	1 370	2.9	170	550	600	650	75.0	81.4	84.1
v)	1.5	90L	1 380	3.8	170	550	600	650	77.2	82.8	85.3
vi)	2.2	100L	1 390	5.1	170	650	700	750	79.7	84.3	86.7
vii)	3.7	112M	1 410	8.1	160	650	700	750	82.7	86.3	88.4
viii)	5.5	132S	1 420	11.4	160	650	700	750	84.7	87.7	89.6
ix)	7.5	132M	1 430	15.4	160	650	700	750	86.0	88.7	90.4
x)	11.0	160M	1 440	22.0	160	650	700	750	87.6	89.8	91.4
xi)	15.0	160L	1 440	30.0	160	650	700	750	88.7	90.6	92.1
xii)	18.5	180M	1 440	36.0	160	650	700	750	89.3	91.2	92.6
xiii)	22.0	180L	1 440	43.0	160	650	700	750	89.9	91.6	93.0
xiv)	30.0	200L	1 450	56.0	160	650	700	750	90.7	92.3	93.6
xv)	37.0	225S	1 450	69.0	160	650	700	750	91.2	92.7	93.9
xvi)	45.0	225M	1 460	84.0	160	650	700	750	91.7	93.1	94.2
xvii)	55.0	250M	1 460	99.0	160	650	700	750	92.1	93.5	94.6
xviii)	75.0	280S	1 470	134.0	160	650	700	770	92.7	94.0	95.0
xix)	90.0	280M	1 470	164.0	160	650	700	770	93.0	94.2	95.2
xx)	110.0	315S	1 480	204.0	160	650	700	770	93.3	94.5	95.4
xxi)	125.0	315M	1 480	234.0	160	650	700	770	93.4	94.6	95.5
xxii)	132.0	315M[1)]	1 480	247.0	160	650	700	770	93.5	94.7	95.6
xxiii)	160.0	315L[1)]	1 480	288.0	160	650	700	770	93.8	94.9	95.8
xxiv)	200.0	As per manufacturer catalogue	1 480	348.0	160	650	700	770	94.0	95.1	96.0
xxv)	250.0		1 480	435.0	160	650	700	770	94.0	95.1	96.0
xxvi)	315.0		1 480	548.0	160	650	700	770	94.0	95.1	96.0
xxvii)	355.0		1 480	618.0	160	650	700	770	94.0	95.1	96.0
xxviii)	375.0		1 480	653.0	160	650	700	770	94.0	95.1	96.0

NOTES

1 Output to frame size relation is maintained in accordance with IS 1231 for all motors except those marked as [1)], wherein the frame size indicated is 'preferred size'.

2 The performance values given in this table for 0.37 kW and 0.55 kW are under consideration and subject to review.

Table 3 Values of Performance Characteristics of 6 Pole Energy Efficient Induction Motors
(*Clauses* 1.2, 1.3, 4.3, 8, 14.1, 14.4 *and* 17.1)

Sl No.	Rated Output	Frame Size	Full Load Speed	Full Load Current	Breakaway Torque in Terms of Full Load Torque	Breakaway Current in Terms of Full Load Current (Equal of Below)			Nominal Efficiency		
			Min	*Max*	*Min*	IE1	IE2	IE3	IE1	IE2	IE3
	kW		Rev/min	A	Percent	Percent	Percent	Percent	Percent	Percent	Percent
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
i)	0.37	80	870	1.4	160	550	600	650	63.0	69.0	71.9
ii)	0.55	80	870	1.9	160	550	600	650	67.0	72.9	75.9
iii)	0.75	90S	890	2.3	160	550	600	650	70.0	75.9	78.9
iv)	1.1	90L	900	3.2	160	550	600	650	72.9	78.1	81.0
v)	1.5	100L	900	4.0	160	550	600	650	75.2	79.8	82.5
vi)	2.2	112M	910	5.5	150	650	700	750	77.7	81.8	84.3
vii)	3.7	132S	920	8.8	150	650	700	750	80.9	84.3	86.5
viii)	5.5	132M	920	12.7	150	650	700	750	83.1	86.0	88.0
ix)	7.5	160M	930	16.7	150	650	700	750	84.7	87.2	89.1
x)	11.0	160L	935	23.0	140	650	700	750	86.4	88.7	90.3
xi)	15.0	180L	940	30.5	140	650	700	750	87.7	89.7	91.2
xii)	18.5	200L	940	37.5	140	650	700	750	88.6	90.4	91.7
xiii)	22.0	200L	945	44.0	140	650	700	750	89.2	90.9	92.2
xiv)	30.0	225M	945	59.0	140	650	700	750	90.2	91.7	92.9
xv)	37.0	250M	950	72.0	140	650	700	750	90.8	92.2	93.3
xvi)	45.0	280S	960	87.0	140	650	700	750	91.4	92.7	93.7
xvii)	55.0	280M	960	107.0	140	650	700	750	91.9	93.1	94.1
xviii)	75.0	315S	970	145.0	140	650	700	770	92.6	93.7	94.6
xix)	90.0	315M	970	175.0	140	650	700	770	92.9	94.0	94.9
xx)	110.0	315M[1)]	970	214.0	140	650	700	770	93.3	94.3	95.1
xxi)	125.0	315M[1)]	970	245.0	140	650	700	770	93.4	94.4	95.2
xxii)	132.0	315L[1)]	980	257.0	140	650	700	770	93.5	94.6	95.4
xxiii)	160.0	As per manufacturer catalogue	980	315.0	140	650	700	770	93.8	94.8	95.6
xxiv)	200.0		980	370.0	140	650	700	770	94.0	95.0	95.8
xxv)	250.0		980	463.0	140	650	700	770	94.0	95.0	95.8
xxvi)	315.0		980	583.0	140	650	700	770	94.0	95.0	95.8
xxvii)	355.0		980	657.0	140	650	700	770	94.0	95.0	95.8
xxviii)	375.0		980	694.0	140	650	700	770	94.0	95.0	95.8

NOTES

1 Output to frame size relation is maintained in accordance with IS 1231 for all motors except those marked as [1)], wherein the frame size indicated is 'preferred size'.

2 The performance values given in this table for 0.37 kW and 0.55 kW are under consideration and subject to review.

ANNEX A
(*Clause* 2.1)
LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
1231 : 1974	Dimensions of three phase foot mounted induction motors
1885 (Part 35) : 1993	Electro technical vocabulary: Part 35 Rotating machines
2223 : 1983	Dimensions of flange mounted ac induction machines
2254 : 1985	Dimensions of vertical shaft motors for pumps
3043 : 1987	Code of practice for earthing
6362 : 1995/IEC 34-6 : 1991	Designation of methods of cooling of rotating electric machines
7816 : 1975	Guide for testing insulation resistance of rotating machines
12065 : 1987	Permissible noise levels for rotating electrical machines
12075 : 2008	Mechanical vibration of rotating electrical machines with shaft heights 56 mm and higher — Measurement, evaluation and limits of vibration severity
13508 : 1992	Test procedure for measurement of loss tangent angle of coils and bars for machine winding — Guide
14222 : 1995/IEC 34-15 : 1992	Impulse voltage withstand levels of rotating a.c. machines with form-wound stator coils
15999 (Part 2/Sec 1) : 2011/ IEC 60034-2-1 : 2007	Rotating electrical machines: Part 2 Methods of tests, Section 1 Standard methods for determining losses and efficency from tests (excluding machines for traction vehicles) (*under print*)
IS/IEC 60034	Rotating electrical machines:
(Part 1) : 2004	Rating and performance
(Part 5) : 2000	Degrees of protection provided by the integral design of rotating electrical machines (IP Code) — Classification
(Part 8) : 2002	Terminal markings and direction of rotation

(*Continued from second cover*)

This standard is based on IEC 60034-30 : 2008 issued by the International Electrotechnical Commission except that additional performance parameters other than efficiency values have also been included which are as follows:

a) Performance requirements have been incorporated;
b) Breakaway torque;
c) Breakaway current;
d) Full load speed;
e) Full load current;
f) Frame size designation; and
g) Schedule of tests.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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Amendments Issued Since Publication

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